

Fieldbus Device Maintenance – Do I Need to Go to the Field Anymore?

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ABSTRACT

The fieldbus era has ushered in a whole new approach to configuring, diagnosing and maintaining a plant's field devices. Field device information that used to require a trip to the field is now available remotely over the fieldbus. This paper will explore the impact that this change will have on the role of the plant engineering and maintenance staff. While remote fieldbus diagnostics will save the user much manpower and money, this paper will identify some of the tasks that should and should not be performed remotely. While there used to be a clear distinction between the role of the control system engineer and the maintenance technician, fieldbus blurs this distinction somewhat. This paper will attempt to clarify these roles in a fieldbus environment. Finally, a review of some of the types of tools that are being made available to maintain fieldbus installations will be discussed

BACKGROUND

When pneumatic field devices gave way to electronic 4-20 ma many years ago, it became much more practical to deliver process measurements over a long distance to a central point. This ushered in the age of the Distributed Control System (DCS). Roles were pretty well defined then. The Maintenance Technician was responsible for keeping a plant's field devices up and going. To do so, the Maintenance Technician spent a lot of time in the field with some fairly straightforward test equipment. Often a good DVM was all that was needed. Meanwhile, the Control System Engineer designed and implemented the plant's control strategy in the DCS Computer. And, of course, the Plant Operator ran the plant from what was hopefully a user-friendly Operator Console. If the system was designed well, the Plant Operator was able to have full access to the key plant parameters while being restricted from changing things that might affect the actual operation of the control strategy.

With the introduction of intelligent field devices in the 1980s and protocols like HART , some of the configuration information for field devices was moved from the DCS out to the device itself. It was now possible for the Maintenance Technician to do things like set the device's range and tag, calibrate the device, and observe various calibration parameters about the device. To do this, the Maintenance Technician would use a Handheld Communication device temporarily connected to the device in the field. Pretty soon, it became apparent that the Technician did not necessarily need to be at the device to do some of this work. PC-based packages were developed that would allow a user to look at and set these parameters remotely over the devices signal wires. Using these packages, many device problems could be diagnosed remotely from the Control Room or the Maintenance Shop. The health of the field devices was still the responsibility of the Maintenance Technician but he now had more effective tools to do his job both remotely and in the field.

With the advent of fieldbus, and FOUNDATION™ fieldbus in particular, even more diagnostic data was available from a plant's field devices. But, in addition to this, it now becomes possible to move the control algorithms (i.e. PID, Lead/ Lag, Ratio, Integration, etc.) out to the field devices themselves. Furthermore, they can be linked together over the fieldbus to form a complete control strategy. The specific roles of the Control System Engineer, the Maintenance Technician, and the Operator now become a little more blurred. The remainder of this paper will deal with the following two questions that arise out of today's smart device environment:

- 1) In a fieldbus environment, how much device programming can be done in the shop and how much still has to be done in the field?
- 2) Who should have read and write access to all the parameters residing in a plant's fieldbus devices (The Engineer?, The Maintenance Technician?, The Operator?, All of the Above?)

REASONS TO PROGRAM A DEVICE "IN THE FIELD"

If all a device's configuration and diagnostic parameters are available remotely in the comfort of the Control Room or Maintenance Shop, a reasonable question to ask is: "Why bother with programming a device in the field at all? Can't I just install the device and get out of there? Or can't I do all this programming ahead of time so I can minimize my time in the field." This question is even more pertinent if the device is in an inconvenient, or even dangerous, location. The answer is, of course, yes and no. Some devices can be totally programmed in the shop and then just taken to the field and installed. The next parts of this paper will address some situations where it is necessary to program the device while physically located next to it in the field.

Before proceeding, it is important to point out two methods of accomplishing the programming of a fieldbus device when it is necessary to be at the device. The first way is depicted in Figure 1 below. Using this method, two technicians are necessary. The first is located in the field with a walkie-talkie and the second is located back in the control room or Maintenance Shop in front of the computer. The second way, depicted in Figure 2, requires only one person

armed with a portable maintenance tool in the field. Although method number one is certainly a valid way to do the job, method number two clearly involves less manpower.

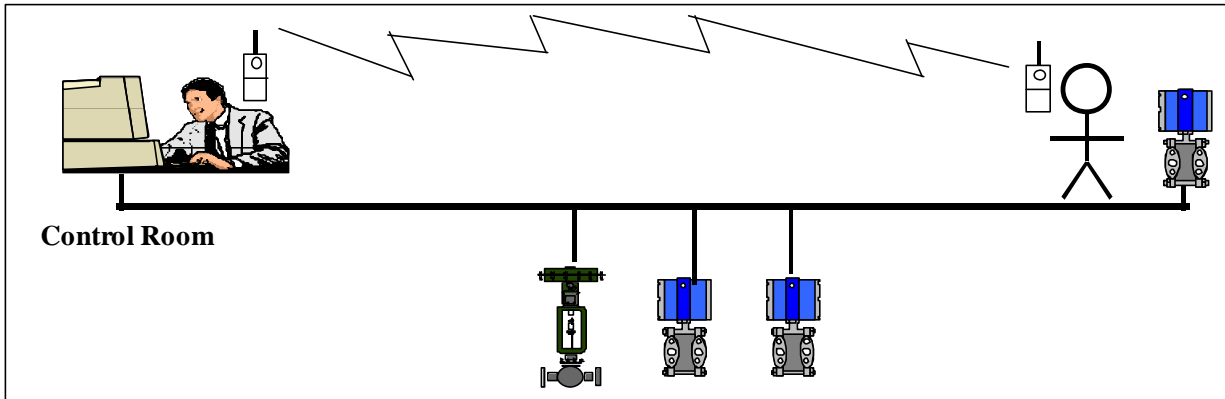


Figure 1 – Field Device Maintenance Using Two People without Portable Tool

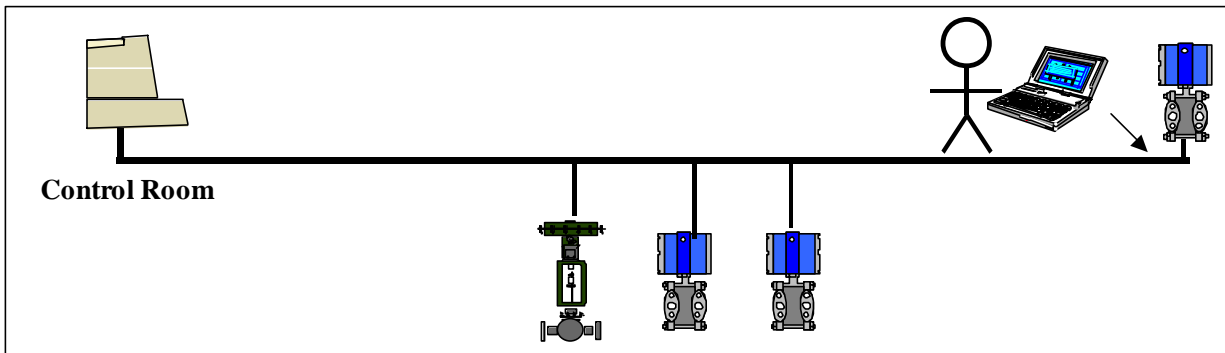


Figure 2 – Field Device Maintenance Using One Person with Portable Tool

CALIBRATION

In many cases, the initial calibration of a fieldbus device can be performed in the shop before the device is installed. A standard measurement is applied to the device and the device's parameters are adjusted to make sure that the values output by the device correspond to the measurement standard. Once the device is installed, the only time that these parameters have to be changed is when it becomes necessary to re-calibrate the device. In most cases, it is more convenient to recalibrate the device "in situ" (i.e. without removing the device and bringing it back to the shop). In these cases, a portable calibrator can be used to apply the standard measurements and adjust the device's calibration parameters. To make this job easier, and minimize the technician's time in the field, some smart calibrators can step the technician through the calibration procedure and then keep track of all the measurements and adjustments that were made to the device. When the maintenance technician gets back to the shop, he can read this information back into the computer and have a complete record of the calibration operations he made that trip.

In some cases, even the initial calibration of a device cannot be done until the device is physically installed in the field. For example, pressure transmitters often read differently depending how they are mounted. In this case, the initial calibration of the transmitter must be done in the field. Another example is when a pressure transmitter is being used to measure the level in a tank. This situation is described next.

ADJUSTING FOR “WETLEG”

An example of when it is necessary to be in the field to perform a device adjustment is the case when it is necessary to adjust for a “Wet Leg” in a tank level measurement. Referring to Figure 3 below, transmitter LT101 is being installed to measure the level in Tank 101. The transmitter has to be ranged such that the pressure when the level is zero must correspond to 0 Feet and the pressure when the level is 20 feet must correspond to 20 feet. Because of the head of water in the pipe below the tank (i.e. H_o in the diagram below), a pressure of H_o must be used to indicate a level of zero. It is impossible to accurately determine H_o without actually being at the tank, filling the “wet leg”, and reading the pressure measurement at LT101. Similarly, to get an accurate measurement of the pressure when the tank is full, the tank needs to be filled to L_{ax} (i.e. 20 feet) and a measurement of the pressure made.

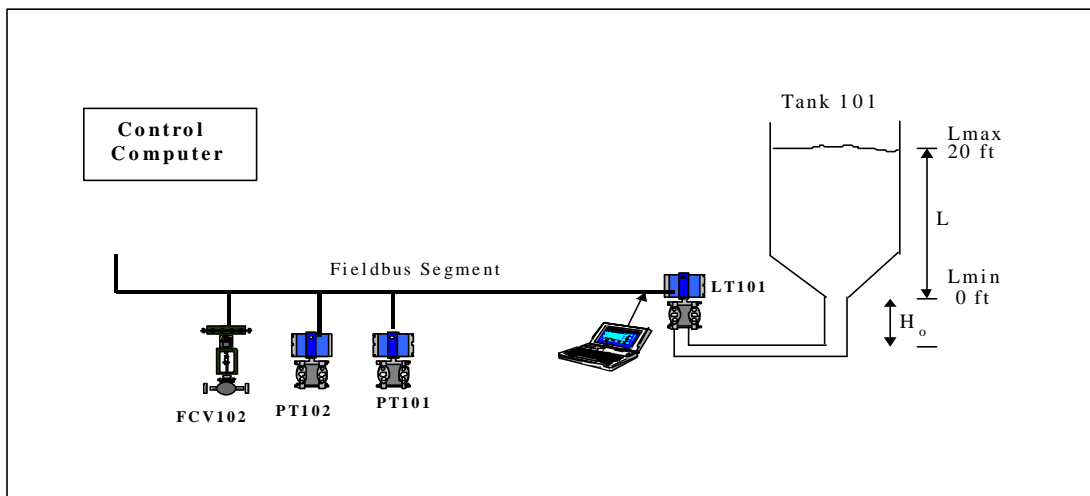


Figure 3 – Adjusting a Pressure Transmitter to Compensate for “Wet Leg”

ADJUSTING FOR A VALVE’S GEOMETRY

The geometry of the valve positioner attachment to the valve may require observing the position of that attachment, and signaling the device when a certain position is reached, e.g. open, closed, or the positioner arm is perpendicular to the valve stem. Again, this could be done with two people. One person would be in the field and visually observe the valve position while the other would be in the control room and set the valve’s parameters when the valve is at these visually observed preset conditions. With a portable fieldbus tool, these settings could be performed with a single person in the field next to the device.

SETTING A DEVICE'S TAG

With fieldbus, the identity of the fieldbus device lives in the field device itself. Actually, there are two tags that identify the device. The Physical Device Tag (PDT) is a long series of numbers that uniquely identify the device. A field device comes with the PDT already in it. It is a unique identifier (i.e. no other device in the world has that unique tag) and cannot be changed. The Tag of a fieldbus device (e.g. FT101, TT101, etc.) is not unique to the device. It can be written into the device depending on how the device is going to be used. If the device is moved to another area of the plant, the device Tag can be erased and rewritten. The Device Tag is the what the control strategy and the operator use to identify the device. This Device Tag can be programmed into the device in the Maintenance Shop or at the factory before the device is shipped. In some instances, however, it might be more convenient to set this Device Tag into the device while the device is being physically installed in the field. In this way, the Maintenance Technician can be absolutely sure he has the right device in the right place before writing the Tag into the device. In this situation, of course, it is necessary that a tool be available to write the Tag to the device while in the field.

AN END USER SURVEY

To get an End User's perspective on some of the topics discussed above, an independent survey of End Users was taken in early 1999. One hundred and eight End Users participated in this survey. Thirty-one of these participants were familiar with fieldbus. The remainder answered the questions based upon their experience with HART devices. Figure 4 summarizes the results for those operations related to the field devices themselves.

	Responsibility?			Where?	
	Maintenance Technician	Engineer	Both	In the Field	In the Shop
Modification of Parameters Unique to a Device	86%	34%	20%	79%	64%
Perform As-Found or As-Left Calibration Checks	98%	4%	4%	77%	53%
Perform Device Calibration or Characterization	97%	10%	6%	70%	68%
Conduct Device Re-Zeroing	98%	4%	3%	91%	33%
Initiate Basic Device Status Checks	96%	12%	11%	61%	37%
Conduct Advanced Device Troubleshooting	92%	28%	22%	76%	40%
Device Communication Troubleshooting	94%	27%	21%	84%	37%
Conduct Fieldbus Network Diagnostics	81%	77%	58%	74%	23%

Figure 4 – Survey on Responsibility and Location of Typical Device Maintenance Tasks

MODIFICATION OF A CONTROL STRATEGY IN A FIELDBUS DEVICE

With FOUNDATION fieldbus, it is now possible to execute entire Control Strategies in the field devices themselves. In most cases, the design and implementation of these control strategies remains the responsibility of the Control System Engineer. Since the Function Blocks, which make up this control strategy now reside in the field devices, however, it does raise the question of what role the Maintenance Technician should play in configuring these blocks. When one looks at the organization of parameters in a FOUNDATION fieldbus device, the answer becomes even less clear. Consider the Function Block Model shown in Figure 5.

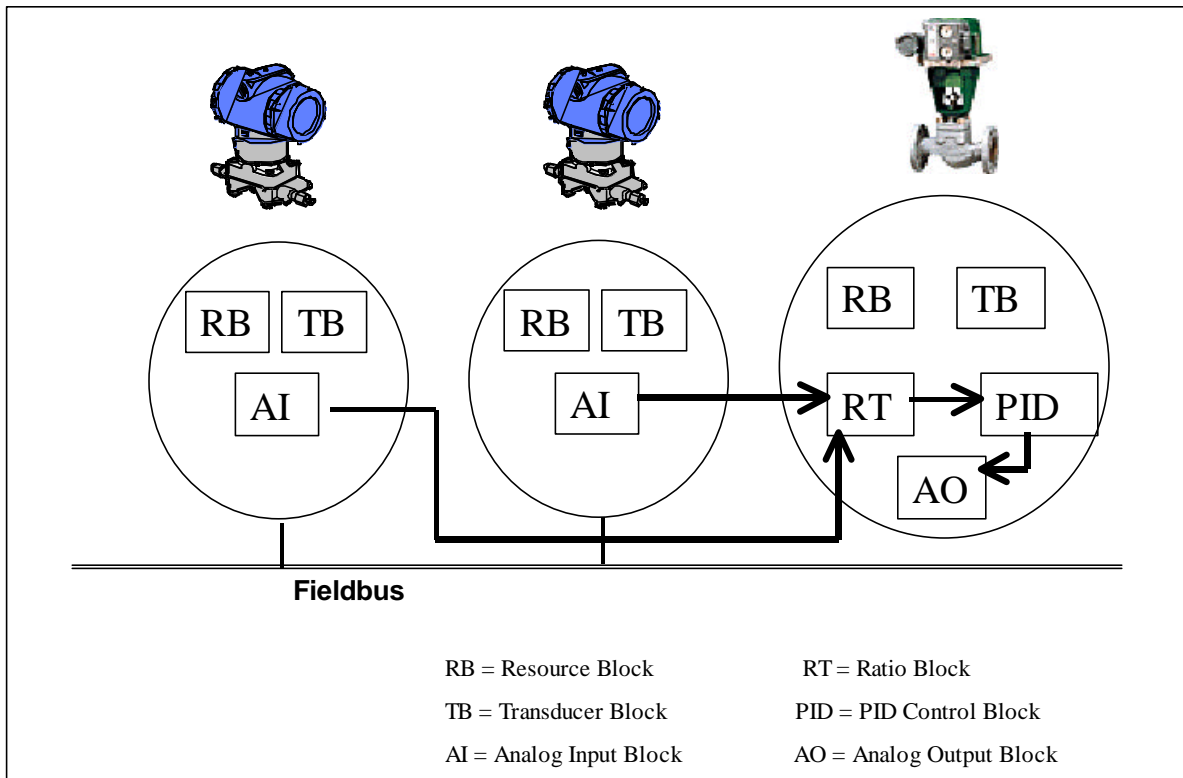


Figure 5 - Typical Resource, Transducer, and Function Blocks in Fieldbus Devices

Parameters specific to the device (both the valve and the transmitter) are located in the block's Resource and Transducer blocks. These would normally be the responsibility of the Maintenance Technician. The Control Blocks such as the PID Block and the Ratio Block are clearly part of the Control Strategy and would be set up by the Engineer. The Input / Output Function Blocks (i.e. the Analog Input and Analog Output blocks) are really part of the device as well as being part of the Control Strategy. It is less clear whose responsibility it should be to maintain these blocks. For example, an Analog Input Block contains parameters related to the mode, scaling, and filtering of the measurement which would seem to be the responsibility

of the Maintenance Technician. On the other hand, the high and low limit alarm parameters would seem to be more important to the Engineer.

In designing a Portable Maintenance Tool for Fieldbus devices, there are several approaches you could take to deal with this situation:

- 1) Give the tool full read / write access to all parameters in the fieldbus device.
- 2) Allow full read access to all parameters in the device, but only allow certain blocks to be changed (e.g. Transducer Blocks, Resource Blocks, and Input / Output Function Blocks).
- 3) Allow full access to all parameters but under security control.

There are advantages and disadvantages to each approach. Figure 6 summarizes the survey responses given by End User on these issues.

Should This Maintenance Task be Security Controlled in the Field?	% That Said Yes
On-line Modification of I/O Blocks	90.30%
On-Line Modification of PID & Control Strategy	87.10%
On-Line Modification of Device Configurations	77.40%
Off-Line Modification of PID and Control Strategy	67.70%
Off-Line Modification of I/O Blocks	67.70%
Off-line Modification of Device Configurations	58.10%
Device Calibrations and Characterizations	45.20%
Network Diagnostics	12.90%
Device Diagnostics	12.90%
Other	9.70%

Figure 6 – Survey on What Device Maintenance Tasks Should be Security Controlled

AVAILABILITY OF PORTABLE FIELDBUS MAINTENANCE TOOLS FOR FIELDBUS AND HART

As of the writing of this paper, the primary portable platforms for maintaining FOUNDATION fieldbus devices are laptop and notebook computers. Several suppliers have such packages

available. Such computers are, of course, not intrinsically safe. There are no known Intrinsically Safe FOUNDATION fieldbus Portable Maintenance Tools on the market at this time. As for HART devices, both a laptop computer solution as well as an Intrinsically Safe handheld tool are available.

CONCLUSIONS

With protocols like FOUNDATION fieldbus and HART, more and more information is being stored in the field devices themselves. This includes information not only about the field device itself but also about the control strategy in which the field device itself is involved. These field devices are, in affect, becoming information servers. In many cases, these smart field devices can be fully programmed ahead of time and then merely installed in the field. Final adjustments, as well as diagnosing of problems, can be handled remotely over the fieldbus. However, there are still some cases where it is necessary for the technician to read and write information to these devices while physically located at the device. For this reason, there is still a need for a portable field tool that can be taken into the field to perform these functions.

As control in the field devices themselves becomes more accepted in the industry, clear responsibilities will have to be defined for maintaining those field device parameters directly related to the plant's control strategy. For now, field tools that change these parameters should do so under carefully controlled security procedures included in these tools.